REPORT RESUMES

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EXPERIENCE WITH TEACHING MACHINES AND PROGRAMMED LEARNING.
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STUDIES OF THE USE OF TEACHING MACHINES AND PROGRAMED INSTRUCTION IN ENGLISH SCHOOLS ARE PRESENTED, INCLUDING ALL LEVELS FROM THE CLASSES FOR FIVE YEAR OLDS THROUGH THE HIGH SCHOOL. STUDIES OF THE READING PROGRAM (ITA), SCIENCE, GEOMETRY, AND MATHEMATIC PROGRAMS ARE DESCRIBED. MACHINES INCLUDED THOSE USING EITHER LINEAR OR BRANCHING PROGRAM MATERIALS. BOTH COMMERCAL AND TEACHER-DEVELOPED PROGRAMS WERE EXAMINED. RESULTS OF THE EXPERIMENTS IN PROGRAMED LEARNING INDICATE THAT CHILDREN USING THESE MATERIALS LEARN AT LEAST AS WELL AS THOSE USING CONVENTIONAL MATERIALS. PROBLEMS OF PROGRAM WRITING ARE DISCUSSED. (BD)

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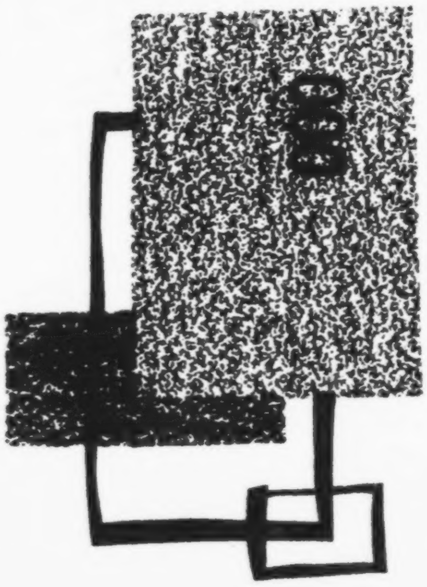

* PENINSULA STUDY COUNCIL

EXPERIENCE
WITH TEACHING MACHINES
AND
PROGRAMMED LEARNING

SCHOOL OF EDUCATION
STANFORD UNIVERSITY
STANFORD, CALIFORNIA

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EXPERIENCE WITH TEACHING MACHINES
AND
PROGRAMMED LEARNING

SCHOOL OF EDUCATION STANFORD UNIVERSITY

November, 1964

FOREWORD

The following report is a reproduction of a booklet received by the Peninsula Study Council and entitled Experience with Programmes and Teaching Machines. It deals with the use of teaching machines in several English schools, and not only describes the procedures but makes several worthwhile suggestions about their use.

Because, logically, teaching machines and programmed learning make good sense, and because Council member schools are examining the problems surrounding the use of teaching machines, it was decided to reproduce the report and circulate it to member districts so that they might gain by the experience of others, particularly since the problems which the group of English schools had to face seem simular to those which are arising in this country.

The reproduction has been made by a photographic plate making process. Because of the process the illustrations in the original, which were not clear, may be somewhat fuzzy, but their inclusion was necessary to avoid expensive reprocessing.

GLOSSARY OF 'ANGLICISMS'

George Bernard Shaw once remarked that the English and the Americans are two peoples separated by a common language. There are a number of terms in this report which may not be familiar to all of its American readers. Accordingly definitions of some of them are given for convenience:

D group - lower ability group

E group - higher ability group

Form - approximately a grade or level

Grammar School - Secondary school for high ability group (top 25%)

Infant School - ages 5 and 6

Junior School - ages 5 to 11 (includes grades of Infant and Primary School)

Primary School - ages 7 to 11

Redundancy - technological unemployment

Revision purposes - review

Secondary Modern - comprehensive high school, open to all

Streaming - ability grouping for differing curricula

EXPERIENCE WITH PROGRAMMES AND TEACHING MACHINES

THEIR PRODUCTION AND USE IN FIVE LEICESTERSHIRE PRIMARY SCHOOLS AND ONE LEICESTERSHIRE GRAMMAR SCHOOL

(This booklet was produced by the Programme Research Unit, School of Education, The University of Leicester, in co-operation with the Leicestershire Education Committee.)

June, 1964

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PROGRAMMED LEARNING AND TEACHING MACHINES

AN ACCOUNT OF THEIR USE IN PRIMARY SCHOOLS AND ONE GRAMMAR SCHOOL

The Ministry of Education gave financial support to a research enquiry into the use of programmes and machines in the Junior School. This research is conducted by the author through the School of Education, the University of Leicester. The grant was made in October 1962, but work had been going on before that time. Since January 1964 the author has been on full-time secondment. The following accounts of projects actually undertaken and programmes written, are by teachers who have been actively concerned with the work. Where results are presented they are often summaries of separate detail which exist in duplicated form but are too lengthy for inclusion.

The purpose of this booklet is to give an account of the advantages and disadvantages of the ideas and practices associated with programmed learning from the teacher's point of view. The examination of differing modes of programming, of the relative effects of programming versus a traditional approach, and the employment of machines as research tools is not the aim of this publication.

Nevertheless, it is hoped sufficient detail is presented for the teacher to assess the statements being made. A future publication is intended which will examine the following tentative conclusions made by the author at this stage.

1. Simple linear programmes have a place in Junior School life. The work is performed as well with masks as with machines unless:
   a) the child needs particular remedial help.
   b) there is need for special motivation.

2. A programme produced by a teacher for his own use is likely to be more successful than a 'standardised' programme covering the same field.

3. Illustrations are of great importance in programming work for Junior children.

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    b) there is need for special motivation.

2. A programme produced by a teacher for his own use is likely to be more successful than a 'standardised' programme covering the same field.

3. Illustrations are of great importance in programming work for Junior children.

4. New ventures in school life can be prepared for by teacher-instruction programmes.

5. It may be possible to 'automate' the learning of reading.

6. Programmes in Science which employ several approaches may be successful in eliciting an enquiring attitude.

7. Programming can extend to small groups using more complex apparatus.

Much of the ground work for these tentative conclusions is outlined in the accompanying articles. Time and experiment may show them to be in error or less than the truth. If the experiments are measured by teachers, it could be a guarantee that the children will gain most.

J. F. Leedham.
Research Unit,
Ministry of Education Grant,
The University, Leicester.

Headmaster,
South Wigston Junior School,
LEICESTERSHIRE.

GLOSSARY OF TERMS

A programme:	A programme represents the body of learning to be absorbed. Within each programme the successive steps are referred to as FRAMES.
Linear programme:	A series of very finely graded steps which have such a pattern that the pupil makes few incorrect responses and receives confirmation of his attempt immediately.
Branching programme:	A programme of graded steps which include estimates of the pupil's incorrect answers. When an incorrect answer is selected, remedial work is indicated and the pupil returned to the main pattern.
Stimulus:	The cue to which reaction is anticipated.
Validation:	The process by which attempts are made to prove that a programme is worthwhile over wider fields.
Target population:	The group of pupils for which the programme is composed. The limit of this population is customarily defined in precise terms by the programmer.

EXPERIENCE WITH TEACHING MACHINES AND PROGRAMMES IN LEICESTERSHIRE JUNIOR SCHOOLS.

J. F. Leedham

Education for the younger pupil today tends to be based on discovery and imaginative creation. The idea of programmed instruction, with its suggestion of rote-learning, conditioning and stimulus-response, appears to pose a contradiction in philosophy - almost in ethics.

At the outset a plain statement might clear up some of this contradiction. Schools which have for long undertaken pioneering work in imaginative discovery for Juniors often share on salutary experience. The 'imaginative discovery' arises from the careful and sustained organisation of situations which lead the child - not beyond the threshold of discovery - but close to it. How close, depends upon the child, and the confidence he has in what already he has achieved before the 'discovery'.

Put simply. Children who are confident in their ability to handle number relationships, because they understand and practise them, are much more likely to produce results in problem situations involving the use of structured apparatus than are children who have had plenty of experience with structured apparatus but whose number relationships (bonding etc.) are suspect.

Teaching Machines in use at Burton-on-the-Wolds School.

A theory of programmed learning which depends upon the observation of behaviour and prescribes future behaviour as a result of these observations is limited. Limited because the flexibility of interaction between teacher and taught has disappeared. Limited because in defining measurable behaviour it appears to deny an adventure beyond the defined horizon. The following accounts of work undertaken in Leicestershire schools are written to present evidence on which teachers can base a judgment as to whether these limitations are real or not. Whether, in fact, carefully prepared material leads to boredom or 'discovery'.

Work in the basic skills of reading and number, excursions into science and 'modern mathematics', together with ventures into programmes for small groups are reviewed below. Summaries of results are quoted where deemed useful.

Reading.

Work with reading programmes should provide a fruitful field for experimenters. After all, the goals can be defined quite exactly and the subjects are known equally exactly; they cannot read! Nevertheless, the labour of organising programmed schemes is impressive. Here is one account of work under way.

Programmed Reading with i.t.a. at
South Wigston.

Ten children who had failed to read after two years of attention in Infant School were presented with a programme which started from simple pictures requiring a spoken response into a tape recorder leading to written response in a step by step linear machine. The programme led up to simple sentences illustrated by pictures and then on to a prescribed reading scheme. The results for 10 children are shown below:

Daniels and Diacks Test.

Average Chronological Age	Average Reading Age. Sept. 1962	Average Reading Age. March 1963	Gain in 22 weeks
7 yrs. 3 mths.	5 yrs. 1 mth.	7 yrs. 3 mths.	2 yrs.2mths

For ten other matched children a programmed approach using Pitmans i.t.a. employed 'listening post' skills. These consist of using taped material broadcast to individual children through headphones and enjoining the use, by the child, of programme cards and programmed responses. The other systems of linear programming such as picture-word response cards were also employed and a typical result is as shown.

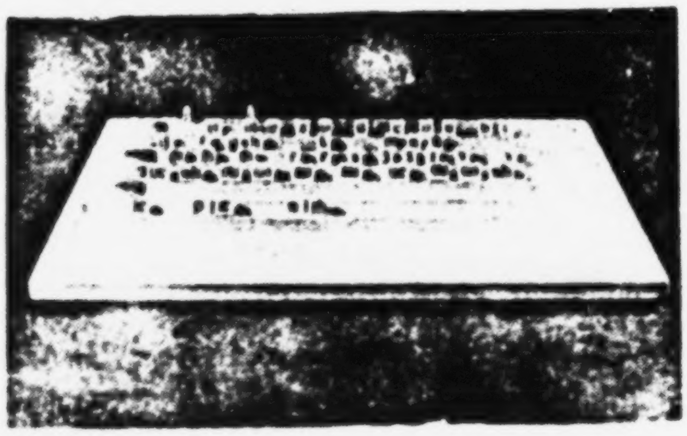
Daniels and Diacks Test.
(Using Traditional Alphabet)

Average Chronological Age	Average Reading Age. Sept. 1962	Average Reading Age. March 1963	Gain in 22 weeks.
7 yrs. 2 mths.	5 yrs. 1 mth.	7 yrs.10 mths.	2 yrs.9mths

Since this gave a result by i.t.a. programme significantly better than the traditional alphabet result, excellent though this was, concentration has since been directed on i.t.a. Several schools have practised 'listening post' skills and developed their own taped system, but a more exciting proposition is opening up.

However well programmes to teach reading are prepared, they preclude the child's personal adventure with symbols. It was soon realised that with the phonetic control that i.t.a. gives, the production of the 'dreamed-of' device which reproduces speech as the child composes symbols was brought close at hand. This is now hopefully and officially underway. If its accomplishment is successful then a totally new approach to the learning of reading is at hand - and with it a very necessary re-appraisal of the ethical value of operant conditioning in the learning processes of young children.

The essential apparatus is being produced at Loughborough College of Advanced Technology under the direction of Dr. P. A. Isherwood and in collaboration with the Author.



i.t.a. Construction
Board.
(handling prototype)

Number and Mathematics.

Considerable experience with American small-step programmes yielded the following results.

T.M.I. Grolier's Multiplication and Division Programme. 1,600 frames from no number experience to average third year Junior School standard.

12 children with A.Qs varying from 67 to 103, Mean 89, working an average of 36 hours, improved on post test scores over pre-test scores by an average of 61%. No other help was given than the programme.

However, it was an extremely mechanical process and the programme took considerable time in completion.

Programmes written by Mr. Clarke, the Head of Burton-on-the-Wolds School, and by Mr. Harries of Swannington School are separately reviewed by them. Ventures with Area Programmes and Volume Programmes supported by separate apparatus are reviewed later. In general, work in Mathematics so far tends to be of two sorts - remedial, taking care of number processes in the decimal base, and programmes which excurse well beyond the normal confines, such as equivalence, geometry of line and point, and set language.

Time Telling Programme.

This programme called for very great revision on eleven different occasions. The difficulty arose from the vocabulary content needed to instruct children who, not able to tell time, were often not particularly able to read. When the final version of the programme was presented to 8 different children aged 8 years working independently with the ESATutor, their average time for 138 frame programme completion was 4 hours 20 minutes and % attainment judged on successful completion of the last 18 frames was 71%.

The same programme was then presented in boxes which act as masks and twelve children working in two groups of six were each set to the programme, working in small group conditions. The situation both as to seating and programme 'cheating' differed considerably from the individual situation of the ESATutor. Their results, judged on the same frames are as follows:

Average time taken 4 hours 15 mins. % success = 82%

The suggestion here is that certain SPECIFIC programmes, especially with younger children, might do better, or at least as well, in small group situations. Again, no particular advantage was observed with machine presentation.

Teachers' Own Programmes.

The experience with programmes introduced from outside the classroom as against programmes produced by the teacher for his own use suggests results will be in favour of the Teacher's programme. A good example of this is a programme devised by a teacher on map reading and representative fractions. This ran to 110 instructional frames and some 50 frames as a revisionary test. This unusual presentation, nevertheless, gave a very high criterion test result across the whole range of a non-streamed class (I.Qs 80 - 118). This programme only stood in need of two revisions to report an error rate of less than 5%. This is a typical experience, but on one occasion, a programme on Volume used successfully for a year within a class, then carefully revised for presentation outside the class, promptly deteriorated in its effectiveness to teach and stood in need of considerable revision.

Science Programmes and Illustration.

A particular difficulty with regard to science programming is how far one is entitled to anticipate experimental results. Work on film strip programmes with Juniors indicated that experimental results would be assumed rather than practised. The difficulty is how NOT to write a programme which includes experimental work and then goes beyond the experimental results by presuming on their correct performance. For example, a programme on 'The Air Around us and the Air we use' includes a section dealing with the composition of the air. The exhaustion of the oxygen from a quantity of air by experimental procedures is suggested, but the existence of nitrogen as 75% of the air has to be dealt with merely by diagrammatic statement. The programme has been under preparation for twelve months with constant redrafting. Its first large trials appear to need two definite inclusions:

1. A considerable degree of illustration by picture and diagram.

2. Groups of experiments and the apparatus which goes with them, both as lead-in material and as criterion tests of what has been perceived and conceived by the child doing the programme.

So far as the point on illustration is concerned it has been our experience that programmes for Junior children should include careful programming of the illustrations as well as the text. The able reader with an I.Q. in the higher reaches will succeed with unsupported textual statement, but the children below 110 Reading Quotient (the majority) appear to need the support of pictorial statement, especially where this gives three-dimensional impression (as in a Volume programme). The point has been made over this that the inclusion of illustrations can be a limitation for reinforcement, i.e. it comes between question and the confirmatory answer, but experience with non-illustrated as against illustrated texts is decisive. Given such a programme as equivalence the removal of the diagrammatic illustration and its substitution by textual statement leads to a rapid decline in criterion result. This has been observed in six cases. It must be borne in mind that revision of the text, which usually involves much remodelling of many frames, also includes re-drawing or re-photographing of the supporting illustrations. The question must be fairly faced and financially provided for in planning programme production and revision.

More Complicated Machinery.

The most familiar complicated machine is the multichoice branching machine/such as the Autotutor or Grundytutor.

Separate reviews of work carried out by these machines are included in this booklet, but one trial with the Autotutor 'O' level Maths programme carried out with 21 Junior School children could bear comment. The detail of this, as in several other of the reported experiments is set out in full in the report to the Ministry dated August 1963.

Number of Schools.	Number of children	I.Q. Range.
4	21	105 - 130+ Average 115

The programme consisted of one reel of 5 chapters entitled:

1. Numbers and Symbols.
2. Literal Numbers.
3. Simple Equations.
4. Common Fractions.
5. Decimal Fractions.

The total number of frames was about 1,300. It must be borne in mind that most of these were 'corrective branching frames'. The results summary is as follows:

Programme.	Average errors.	Average Time.	Pretest to Post-test Gain, out of 10.
1.	9.4	1 hr. 41 mins.	4.3
2.	8.1	1 hr. 40 mins.	4.1
3.	7.7	1 hr. 30 mins.	4.9
4.	2.7	57 mins.	4.7
5.	3.9	1 hr. 12 mins.	4.3

In conclusion I wrote:

"One could make no greater claim than to say that with able Junior School children a sophisticated branching machine did not impede their ability to learn fresh material, that this learning appeared to be retained and that it was gained with only the assistance of programme and machine".

The Group Console and the Programme Assessor:

Much of the work so far carried out suggests that extremely simple machines or masks, together with illustrated and well tested linear type books used with masks, will be the style of administration for the individual in Junior schools. Nevertheless, there are two areas to which Junior School research must be devoted:

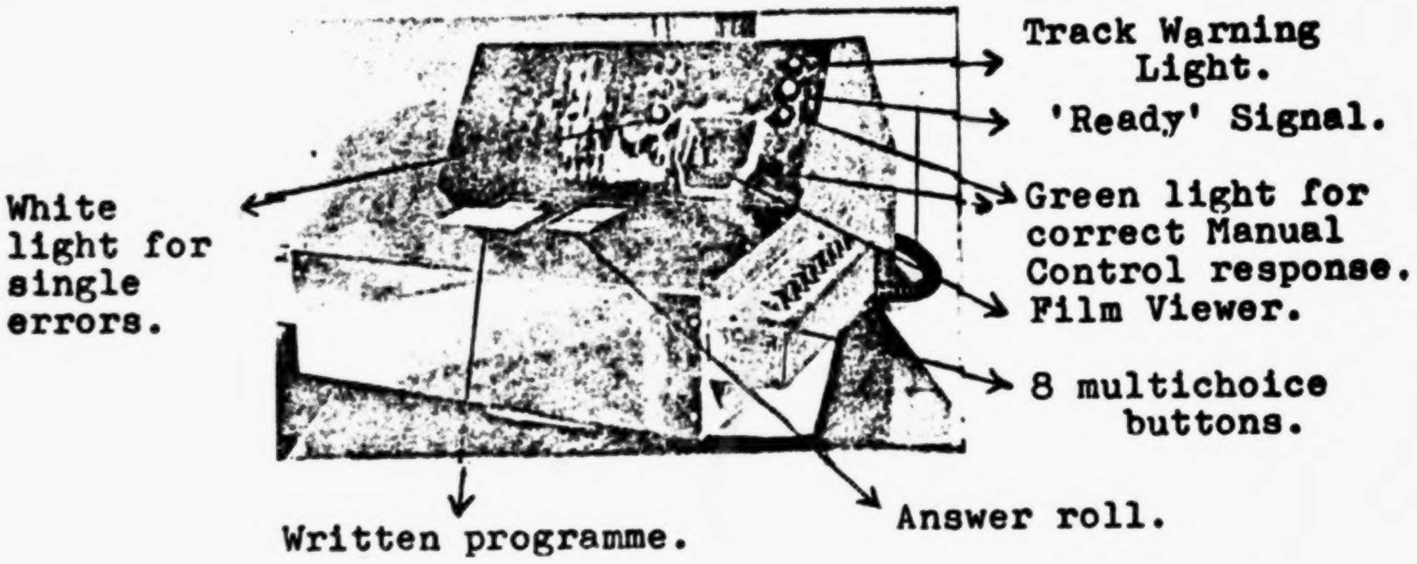
1. Which types of programming suit specific programmes and populations?

2. How can programming include the social benefit which comes from learning in the small group?

So far as (1) is concerned, our early efforts are devoted in the following direction. Dr. Kind, the Schools Medical Officer, has been associated with the development of this work, particularly from the point of view of its technical and electronic application and the illustration of the Kind/Leedham Console, constructed by Dr. Kind, is best explained as follows:

The left-hand Console is electronically controlled by the right-hand Console, which carries the master circuits, counting systems, the error control system (and a shrill sounding device which warns of efforts to 'cheat').

Referring to the left-hand console


Track Warning Light.
'Ready' Signal.
Green light for correct Manual Control response.
Film Viewer.
8 multichoice buttons.
White light for single errors.
Written programme.
Answer roll.

The written programme can be coded in 4 different ways.

1. Straightforward Linear with constructed response and single Multichoice selection for moving on.

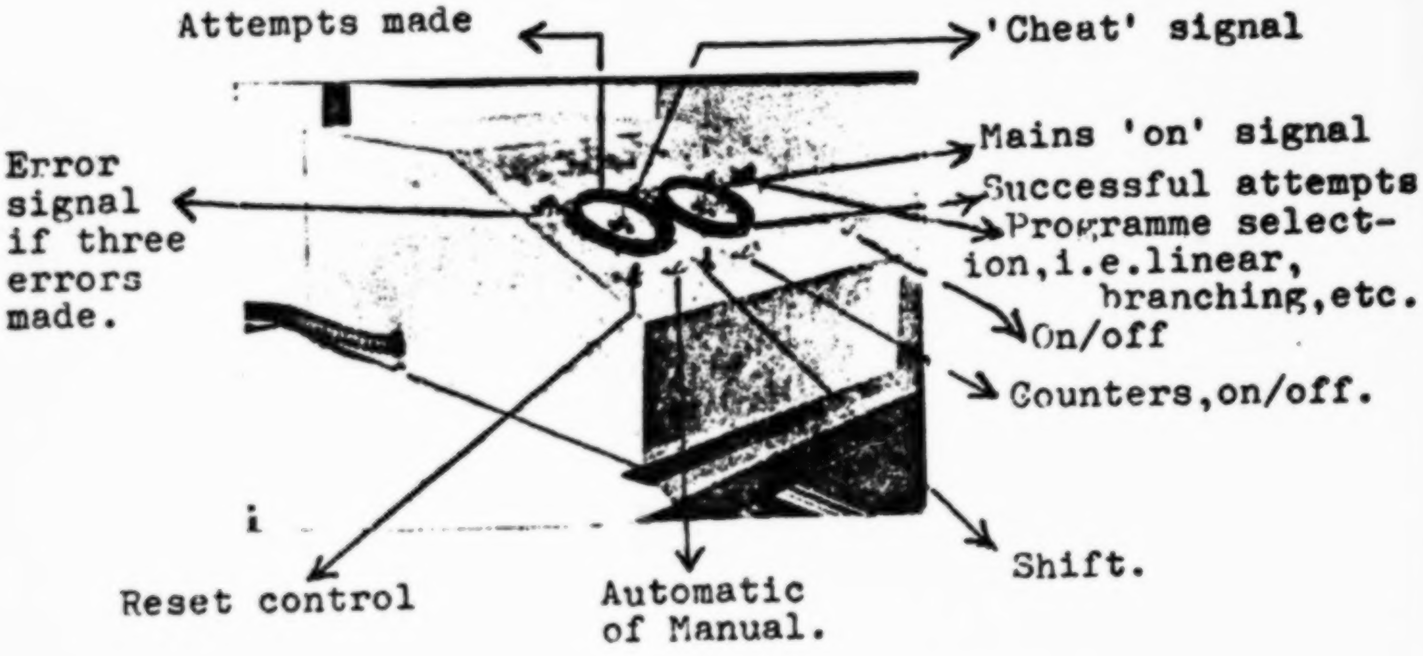
2. Double Multichoice - which requires two correct selections for moving on.

3. Skip Branching with successive either/or branches.

4. Straightforward linear.

Each programme can be supported by illustrative programmes on film strip seen through the viewer and by automatic slide illustration controlled by the left-hand console and projected by an N 12 Paximat viewer.

Referring to the right-hand console.
This controls all the programme presentation by the left-hand console and analyses the results:


Attempts made
'Cheat' signal
Error signal if three errors made.
Mains 'on' signal
Successful attempts
Programme selection, i.e. linear, branching, etc.
On/off
Counters, on/off.
Shift.
Reset control
Automatic of Manual.

This console contains the control circuits and power supplies and leads on to the next intended phase of presenting programmes to groups. The controls and exhibitions are as follows:

Error-signal - Red. If three consecutive errors occur (the programme only moves on for correct selection) this signal lights up and remains illuminated until the teacher has cleared up the matter and depressed the 'reset control'.

Cheat-signal - Red. Any effort to 'outsmart' the multi-choice by multiple pressing of buttons etc. is detected, the alarm bell sounded and the machine inactivated.

Counters and Scoring. The Counters are under separate control and indicate simultaneously:-
1. Total attempts made.
2. Successes achieved.

Automatic-Manual. The pupil's console can be set so that he progresses automatically on his own correct selection or at his own speed after correct selection.

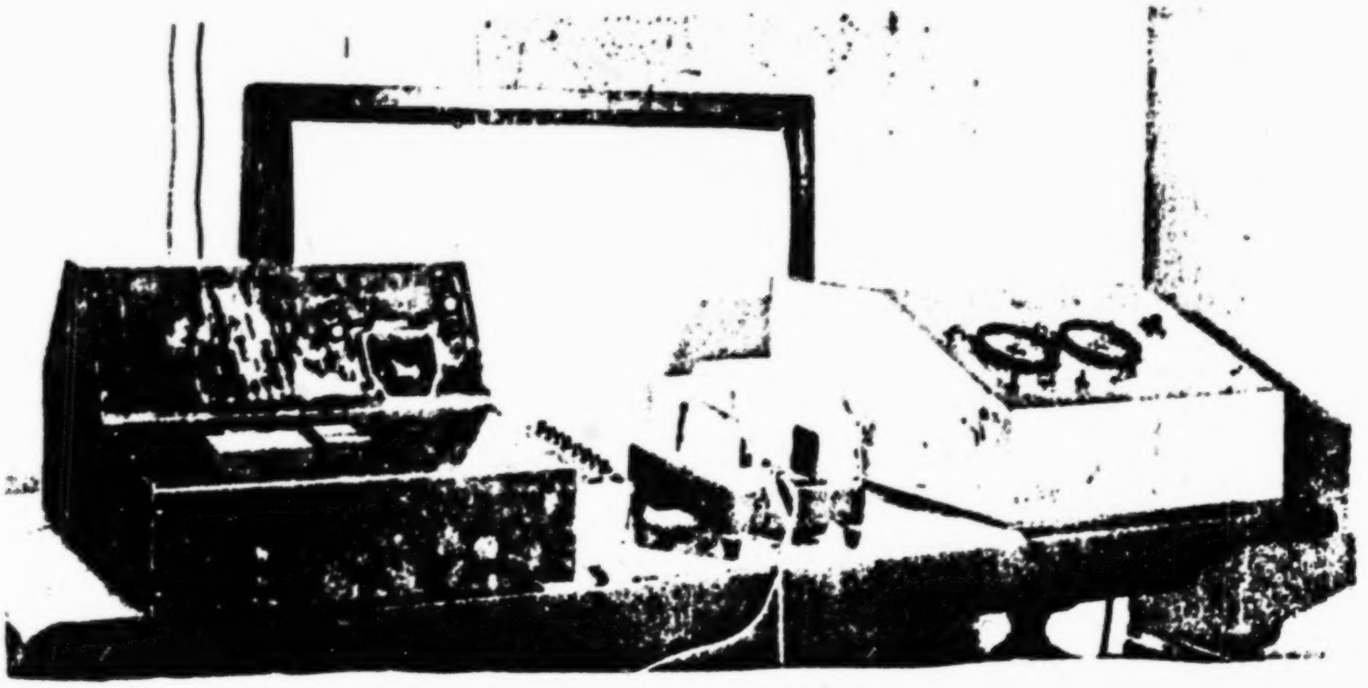
Shift Control. An over-riding Shift Control can progress the programme to any point needed.

The object of this device is entirely for research. It should give full facility for presenting the same programme in differing modes, for assisting programmes with illustrated material, for examining different programme control procedures and assessing pupils' performance at any time during the conduct of experimental work.

The major aim of the console however is to lead to the situation wherein programmes will be tackled by small groups of pupils up to eight in number. This project is actively under design and should be operative before long with science programmes.

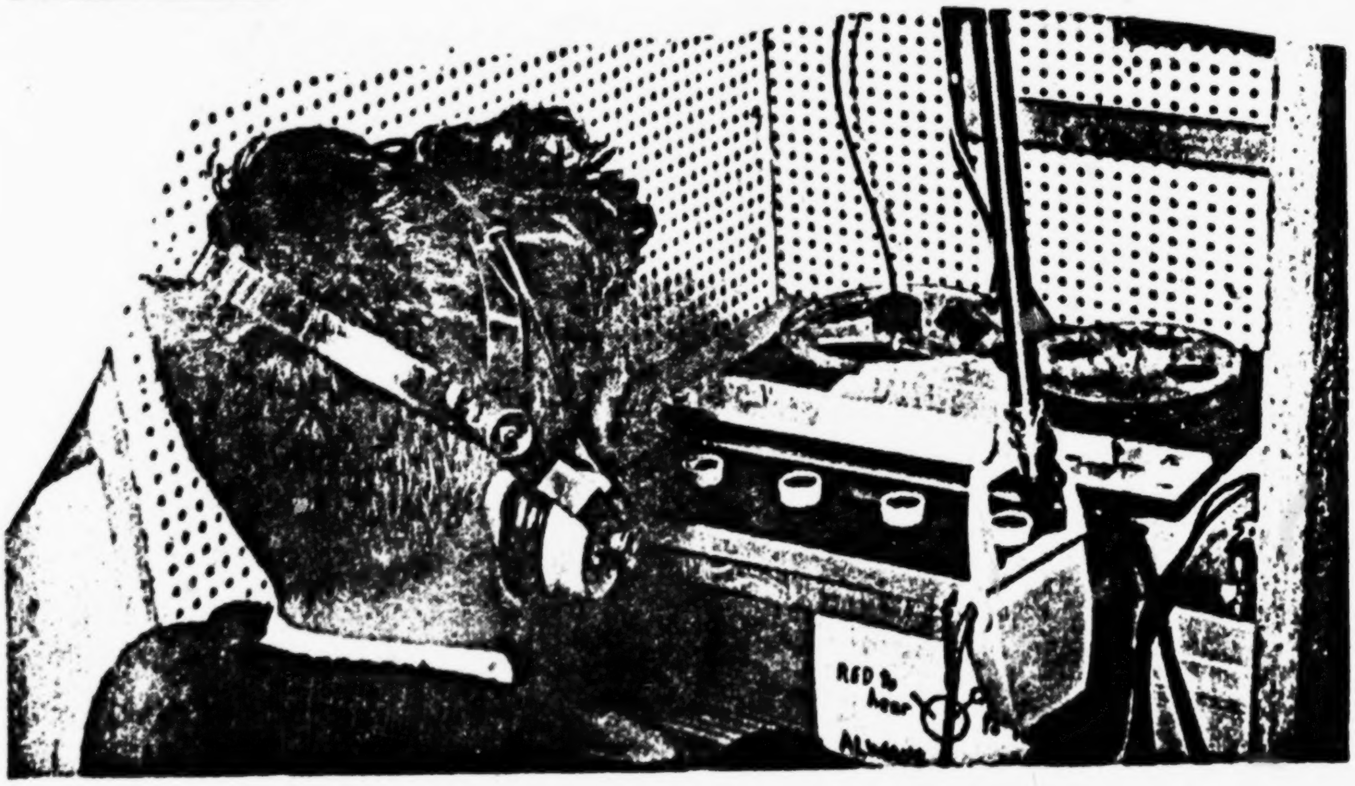
Thus it would be a fair indication of my work to suggest that for groups and for reading skills, somewhat advanced but reliable electronic devices and consoles will be required, but that otherwise extremely simple masks and books with carefully designed programmes for SPECIFIC needs will meet the case of the Junior School.

Since the entire field of work is highly experimental and sensitive, it is to be hoped that contributions by teachers will be increased and defended on the basis of their effectiveness. It is important that their effectiveness also preserves the intent and ideas of 'discovery' and imagination which Junior Schools have developed of late years.



The Kind/Leedham Research Console.

Group Work with language laboratory and automatic slide presentation.



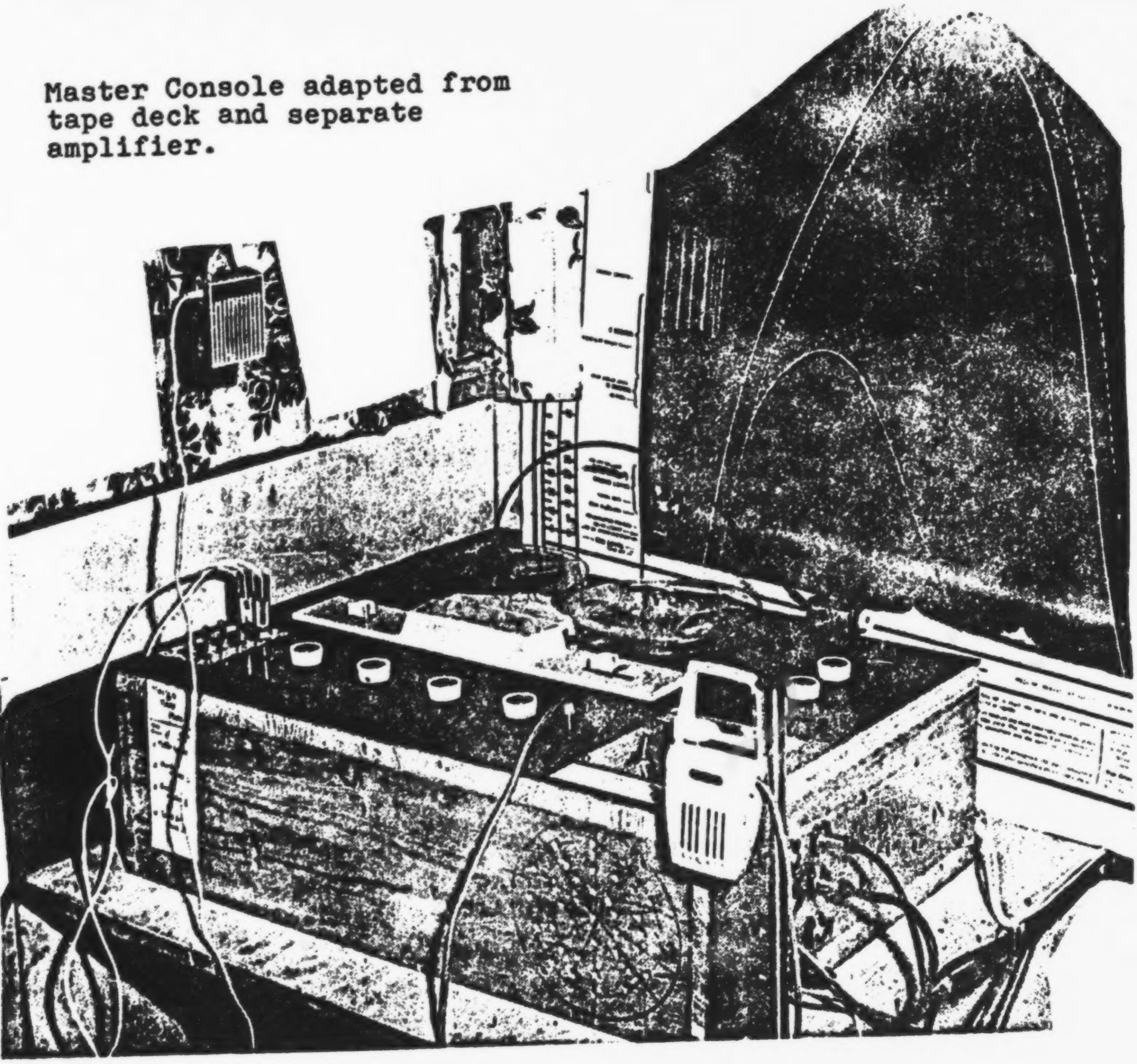
Work has been underway for some time with a group of four inter-connected tape recorders which have the facility of editing material from, or to, a master tape.

Six Junior boys, so far, have become familiar with the necessary routines of working from a master tape. They have then carried on to viewing a matched programme of slides about Atmosphere and Weather. Their responses to this have been made on their own tape and re-edited as a subsequent master programme. Considerable experimentation is necessary in this area to ensure that a programme can indicate the general line of approach; can reinforce preliminary instruction by illustration and experiment and then can be so organised that the programme only proceeds when the group achievement is rational and mutually supporting. This venture, of course, fits into the planned scheme of the group console mentioned earlier. At present it is housed in a mobile caravan to meet space shortage and transport problems.

There is no doubt that a teacher, given equal facilities, could achieve at least the same results.

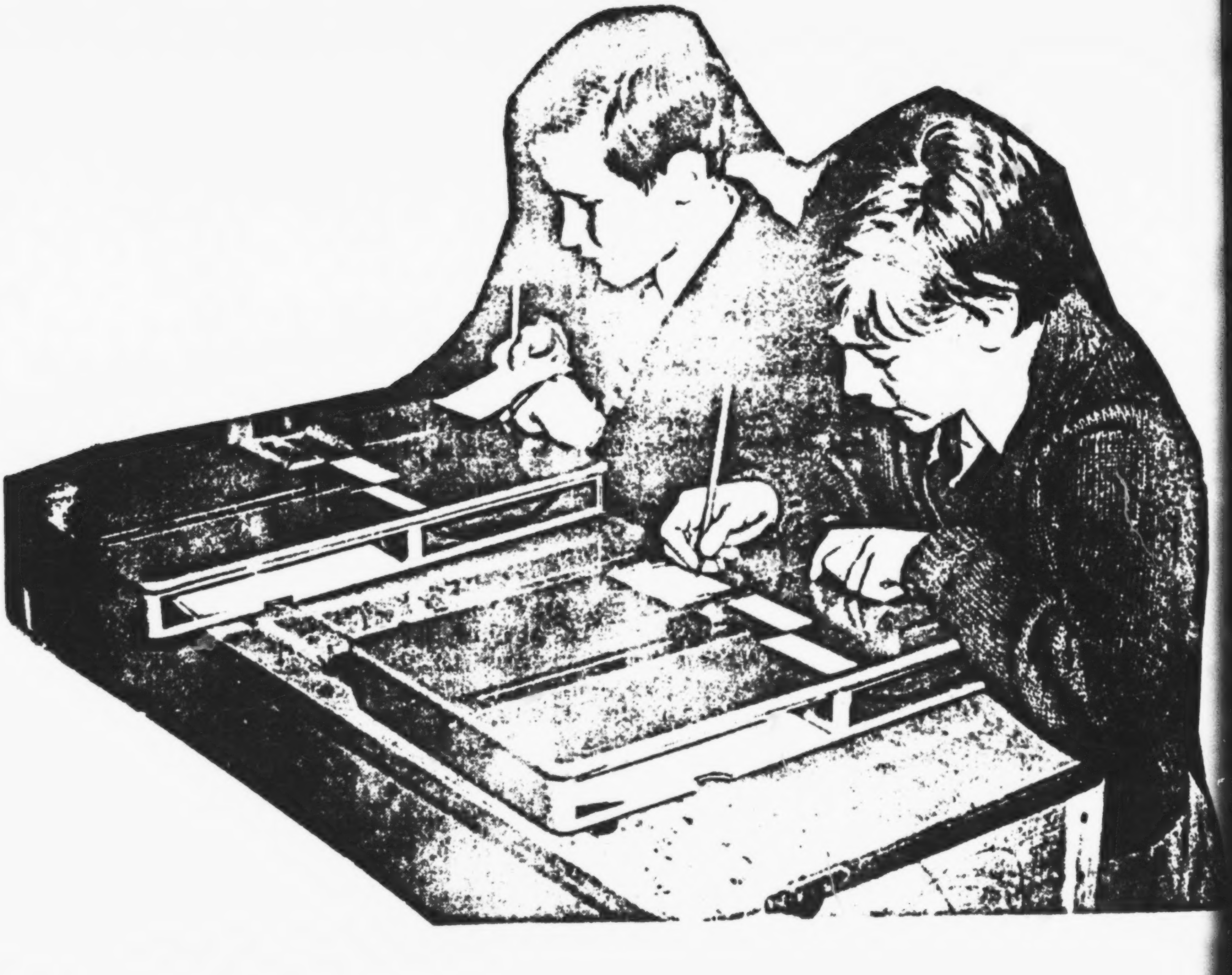
The circumstances are to be so organised, however, that, given the understanding and support of the teacher, small groups of children will move successively through the same 'programmed situation' which will contain the possibility of adapting some part of the situation to the varying needs of varying groups and individuals. This should relieve the teacher of a large measure of organisation and permit him to share in the discussions and discoveries to which the programme should lead.

Master Console adapted from tape deck and separate amplifier.



PROGRAMMED LEARNING IN A PRIMARY SCHOOL CLASSROOM

D. Lane.



Junior Children with ESATUTORS.

PROGRAMMED LEARNING IN A PRIMARY SCHOOL CLASSROOM

The relatively slow spread of the use of Programmed Learning in the Primary School classroom can be put down to two main causes, doubt among members of the profession of the continuing need for large numbers of well-qualified teachers if Programmed Learning proves generally successful and a very real fear of the disruptive influence it might have in classroom life.

Reassurance on the first of these points is easier to offer than on the second. The teacher in the classroom is vital. Without him no Programmed Learning could take place. He it is who knows each child's abilities and can decide when individual support from a programme is desirable. No one else is in a position to make the appropriate choice of programme. The teacher's attitude is all important, for experience over the past years shows that the most lasting successes come when child and teacher make a corporate effort, the child to master the programme and for both to work together subsequently to ensure that the immediate gains shall become a secure part of the child's learning. Also, the majority of children seem to need the moral support of the teacher's belief in their ability to benefit from a specific programme. Let those teachers who fear redundancy take heart. As Doctor Z. P. Dienes said as recently as January, 1964, "Teaching is an Art and always will be".

Fear of disruption on classroom routine is an illusion. Those working with unstreamed classes have the opportunity to derive the maximum benefit from the use of Programmed Learning. Children can set up the programmes for themselves or for each other, in a machine or by making use of a mask. Using a programme is simply one more activity amongst several or many going on together. No more of a ripple is made in the classroom situation than by any other piece of work being undertaken by an individual or small group.

This is borne out by visitors' reactions to the overall picture. All visitors discuss with the children the machines themselves and the programme content. They should carry away helpful impressions, since the children's contributions are always candid. One of the good things emerging from the use of Programmed Learning is that children are critical of the machines themselves and show some ability to evaluate the programme in relation to their needs.

The age range of this class is 10+ to 11+. The class roll has averaged thirty-six since we embarked on our first programmes. These were 'English Skills', written by J. F. Leedham, and 'Primary Arithmetic', by Mr. R. Bews of Linden Junior School, Leicester. Classroom administration can be very simple, as both sets have each separate packs in a tough cellophane cover and the packs themselves, clearly numbered for reference, stand in a re-inforced cardboard box. A simple chart can show each child's coverage of the set.

In 'English Skills' children find the rate of progression offered is encouraging, while the length of programme appears to suit all ranges of ability. All complete a programme satisfactorily, though some less rapidly than others. In an unstreamed class with a wide range of ability, the packs are used with discrimination, where and when each is needed. Some children need only the last two of the packs. Others, such as three who for various reasons had attained the Third Year unable to read, and after having been given some months with i.t.a. came to the Fourth Year at the i.t.a. transfer stage, have derived great benefit from beginning at the first pack. It has been said, "It was only experience that showed that the mode of programming could absorb reading difficulties". (Experimental work with Teaching Machines, J.F.Leedham, Forum, Spring 1964). This is a clear instance. The children in question showed improvement in Spelling, but the most marked gain and the one bearing long term promise was in their growing confidence. All three had been happy in discussing work but shrank from attempting to put down their ideas in writing, the result of years of frustration. One of the three, faced with the writing of a story after completing Pack 1, certainly used the vocabulary learned, but in a completely different setting. Enthusiasm between pupil and teacher helped. As I see it, teacher and programme writer are complementary.

'Primary Arithmetic' series has been used in the same way. Children are happy with it and benefit. Every child who has not needed the earlier packs has gained from working those on fractions and equivalence, especially as work with Dr. Dienes' Algebraical Experience Material goes on too.

Boys of an E group worked enthusastically and with complete success on 'Telling the Time'. Girls of a D group were completely at sea with it and offered an example of children needing much help with a programme. This seems to show that though a particular programme has proved successful in many fields it cannot be taken for granted that its method of presentation will meet with success invariably. Two children worked for the requisite number of periods required for experimental purposes on the Autotutor Mark 2. An unusual feature was that they showed no disposition to talk of their experience.

Validation work on programmes has been extremely interesting. One gains valuable insight into the teaching of others and cannot fail to benefit from studying the attitude of pupils to fresh material or to differing methods of approach to a familiar subject. For validation purposes we have worked the following programmes:-

Area	J.F.Leedham, & Mrs.D.V.Parker	South Wigston County Junior School, Leics.
Geometry of the Point & Line.	C.G.L.Harries	Swannington C.E. School, Leics.
Sets.	J.Clarke	Burton-on-the-Wolds County School, Leics.
Volume	J.F.Leedham	South Wigston County Junior School, Leics.
Atmosphere	J.F.Leedham	South Wigston County Junior School, Leics.

Having proved that Programmed Learning could be absorbed easily into the day by day working of an unstreamed class, I wrote 'Introduction to Map Reading by Statement and Representative Fraction' as an adjunct to map work in Geography and for inclusion with some group and individual Mathematics. It is worked with an ESATutor or a mask, as we have only one ESATutor available permanently in the classroom. A fully comprehensive test is worked from two to three weeks later. Statistics have been recorded carefully. Results over the period of the last ten months show that any eleven-year-old of average reading ability can accomplish the work with success. For purposes of comparison the programme has been worked also by children in a parallel class, by a boy from a village school and by three children in streamed classes from two very formal schools under another Authority. Results in all cases have been satisfactory.

To give the class as a whole, or small groups, an opportunity for gaining information in a fresh way, in reasoning out situations presented to them and for discussion, I made tape-recordings to synchronise with the showing of colour-slides to illustrate 'Sea Birds of the

Scilly Isles'. This has been enjoyed by my own and a parallel class. Both sets of test results made it clear that in many cases children of relatively low ability showed to advantage.

Though Mr. J. F. Leedham has said "This is not a programme in the strict sense of the word", it is quoted because it seems to me that workers in the field of Programmed Learning are by no means sure yet of all the possible techniques that will prove of value. If programme presentation were to become stereotyped, much of the value to adventurous minds would be lost. The more people with wide classroom experience who will experiment in this field the better it will be for the future of Programmes Learning.

REPORT ON THE USE OF PROGRAMMED LEARNING IN A THIRD YEAR CLASS IN SOUTH WIGSTON JUNIOR SCHOOL, WHICH IS UNSTREAMED.

B. G. Harris

Since September 1963, members of the above class have been using a branching programme in a multichoice machine, and various linear programmes, both by means of a machine and by means of improvised methods of presentation. Most of the work has been of an exploratory nature, but greater use is being made of programmed learning in remedial situations. Children from other classes attend in respect of both.

The whole of this work fits into the normal classroom routine and the children engaged on it proceed unheeded by the other members of the class. They appear to enjoy doing the work, and the slower children in particular receive great encouragement from the fact that they make so many correct responses.

The Grundy Tutor in use at South Wigston.

Branching Programmes.

The multichoice machine being used is the Grundytutor, which is on loan from International Tutor Machines Ltd., Ashford, Middlesex. Seven children, chosen from the three third year classes, have been using the machine with an I.T.M. 'Primary Arithmetic Revision' programme. The target population of the programme is children of age 10+ and the aim is to revise all the arithmetic that children should know on leaving primary school. Each child has spent a half hour on each of four days every week on this programme, which is in its unvalidated state. The intention has been to help with its validating and to assess its suitability for use in junior schools. To comment on our findings at this juncture is not possible because the programme is not in its final state.

In addition four other children have used this machine with the VALIDATED first volume of the 'Primary Arithmetic Revision' programme. This was not received until the first seven children had started on the second reel of the unvalidated programme, and so it has not been possible to have more children working on it. The first volume of the programme covers number, addition, subtraction, multiplication and division, and the four children using it completed the supplementary tests at the end before starting on the programme itself. The results of the pre-test and the post-test are shown below.

Subject No.	%-age errors Pre-test	%-age errors Post-test	%-age Gain or loss.
1	30	10	+20
2	45	40	+ 5
3	40	30	+10
4	40	10	+30

Linear Programmes.

These consist, in the main, of the ESATutor programmes, 'English Skills' Sets 1 - 10, 'Primary Arithmetic' and 'Telling the Time'. They are presented, either in an ESATutor or in hard-board masks, and are principally used in remedial situations.

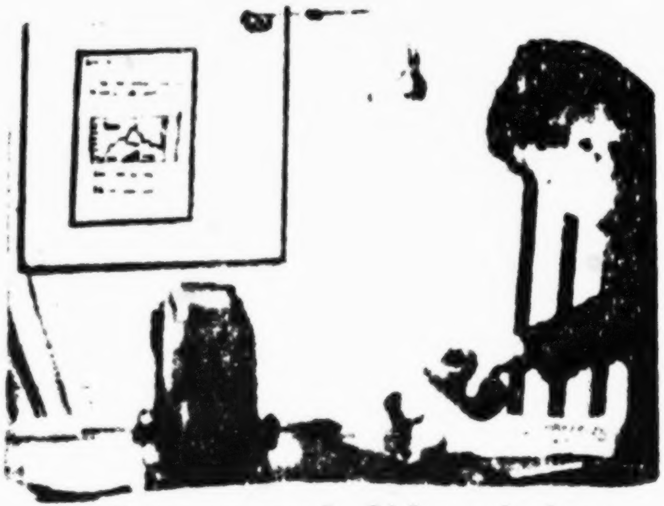
Seven girls who were unable to tell the time, each worked through the 'Telling the Time' programme. They worked entirely on their own and received no supplementary instruction. After completing the programme they were able, without exception, to tell the time with accuracy to the nearest five minutes, and testing the same children five months' later indicates that there has been an improvement in their performance since then, except in one case. Doubtless this is because they have been making use of what they have learned.

'English Skills' Set 1 - Capital Letters and Full Stops, and Set 2 - Simple Punctuation, have been used remedially with only a limited measure of success by eight of the less able members of the class. 'Primary Arithmetic'

Sets 2 and 7 have been used in a similar way, and with similar results.

The remainder of the sets of the 'English Skills' programme are used to teach spelling and for vocabulary extension. Altogether, only seven children have been involved in this aspect of using the programme. It has been found that the transference of what they have learned to their normal written work has been better with vocabulary than with spelling.

Working with these programmes emphasises the need for including good and numerous illustrations and practical discovery work in programmes for the junior school. A development is being worked on at the moment, and a prototype machine is expected to be in use at the beginning of March. This new machine will provide an additional aperture of about 2½" x 3½" through which an illuminated filmstrip may be seen. In addition to the obvious advantages of enriching programme writing, it will be possible for any filmstrip, either to be programmed or to have a commentary written on it. Also it facilitates diagrammatic presentation of instructions for practical work.



Programmed film strips

Three programmes have been prepared for use in this machine and two are already in filmstrip form. It was thought, at one stage of the development, that a merging of the illustrations with the verbal material would be better than the method outlined above, and the two films were made on this basis. However, they are not wasted because it has been found that they can be shown through an ordinary projector on to a screen. In fact, this is how the programmes have been presented in the absence of the proper machine, and a manilla card stuck to the wall has been used instead of a screen. An outcome of this method of presentation has been the use of a projected programmed film strip in the group situation, each child having an answer box or booklet enabling him to receive immediate reinforcement.

The two programmes in use are both on Science: 'The Air Around Us and the Air we Use' by J.F.Leedham, and 'Electricity and Simple Circuits' by the author. Neither has been validated, but the results of using them in the classroom are encouraging. 'Electricity and Simple Circuits' is the programme that has been in film strip form the longer, and it has been worked by twelve members of the author's class. Also, six group leaders from a fourth year class worked the programme prior to performing experiments on the subject, based on a television science series. The television lesson was seen by the whole class after the group leaders had worked the programme. It was found that the group leaders were able to use what they had learned from the programme to supplement the knowledge that the class, as a whole, had gleaned from the lesson on television, and the result was successful.

The time taken by the children to work the above programme varied from 1¼ hours to 3½ hours, and the average time taken was 1 hour 56 minutes. The average error rate of responses was 3% and an average of 80% correct answers was obtained in the supplementary test at the end. It is too early, at this stage, to give results of using the other programme as only two children have used it so far. However, the results that have emerged are as encouraging as the above.

It is often maintained that, after a suitable matrix and scheme have been worked out, programme writing becomes straightforward.

Here is an account of a programme which had been carefully prepared, subjected to correct procedures and then handed on for development to a practising teacher who had experience in modern methods of mathematics teaching.

J.F.L.

THE DIFFICULTIES AND PROBLEMS I HAVE ENCOUNTERED IN WRITING A PROGRAMME.

D. V. Parker

At the present time I am engaged in helping to produce a programme on Area. May I make it quite clear that I am not an expert, far from it. This programme was first written by Mr. Leedham and I became involved when I used this programme in its first rough state with my class. Part of it dealing with the area of triangles needed rewriting and I agreed to try my hand at it. Since then the programme has been tried out in other schools and is now being rewritten. It is not yet finished and I shall learn much more about the difficulties before it is finished.

Obviously the first difficulties will arise in deciding on the form the programme is to take. This is largely settled by the subject of the programme and how it is to be used. Mr. Leedham had decided that ours should be a multichoice type, the children selecting one of four possible answers. He had also decided that the programme would be on loose sheets, two frames to a page, that these would be in a plastic folder and would pull out to expose the correct answers. This caused us to meet our first problem. It was necessary for validation purposes to print it as a book. This meant changing our layout and raised problems as to how to mask the answers until the child was ready to check. The biggest trouble arose over the difficulties of printing in two colours. We had used red to stress certain points but this had to be abandoned.

One major problem lay in deciding just what to include and what to omit. Let me quote the Area programme.

Any child ready to tackle area would obviously be able to measure and would know what we meant by an inch and a foot. They should be familiar with the terms triangle and square, but would they know what we meant by a right angle or a perpendicular? Would they be baffled by a scale drawing? Was a scale drawing necessary? Eventually it was decided that these must be included in the programme and it would not be safe to assume that the children would already be familiar with them. The programme, therefore, would have to explain these terms to the children. But how far can one go with this? A programme must be self-contained. It is no good if half-way through a programme the child has to leave it to learn a process necessary to enable him to complete the programme. In many cases the child would not even realise that he has a gap in his knowledge that makes it impossible for him to complete the programme successfully. At the same time teachers trying to use programmes to help them lighten the task of teaching too many children at once are not going to think much of a programme that asks them to teach the children dozens of facts or processes before they can tackle it. They would immediately say that they might just as well teach the whole thing. But obviously the programme must have its limits, and it is quite a problem to decide just where that limit is. Put in too much and the programme becomes unwieldy, dull and boring. If you are not careful you miss the point. Put in too little and the children find it too difficult and the programme fails.

You have written your programme. Now your troubles really begin. With the Area programme we tried it with one class in our own school, children younger than those the programme was intended for. It appeared to work well so the programme was duplicated and sent to other schools to be tested. It was also given to another class in our school. The results of this were surprising. Collecting together the results we found the error rate was far too high and the results of the tests were very poor. Why should a programme work well in one school but not in another? This could perhaps be explained, but why should it work well with one class in a school and fail miserably with another class in the same school?

Having tested the programme it was now time to study the children's answers and find out why they were wrong. In some cases this was easy. Often it was a simple case of re-wording the question. In many cases it was necessary to introduce easier steps. In other cases it was not so easy to see why the children failed; in some it was impossible, only the children themselves could know how they arrived at their answer! It was at this point that I really came face to face with the difficulties of this business.

I realised for the first time just how difficult it is to word a question in such a way that the children knew just what you meant. For example, in one frame we had drawn a square whose sides were one inch long. The children were asked to measure each side. Many gave the answer as four inches. We realised then that we should have asked them to measure one side, not each side. In another frame a rectangle had been divided into two right-angled triangles. The children were asked how many right angles in each triangle. Again we discovered that we should have asked how many right angles in one triangle, not as we did, in each triangle. Looking at it now it seems so obvious; we feel we ought to have spotted this sort of thing before. We have rewritten the programme and hope we have worded the questions carefully, but knowing children I am prepared for them to find some of our carefully worded questions vague or ambiguous.

As I said before, in some cases it was obvious that more steps were necessary. Here we were again faced with the problem of how much we could put in and how much dare we leave out. We could not overload it and make the programme too long, but we must add something. I can see the rewritten programme coming back after testing and we shall again be faced with this question: how many more frames dare we put in? A point arises here about a difficulty I found when rewriting the programme. This might be a difficulty that is peculiar to me. I had two frames in the original programme and the step between the two had proved too great, more frames must be inserted. I would spend a whole evening carefully working out the steps to be included, wording the questions as clearly as I could, only to find that I had got myself up a blind alley with no way out. The next step would still be too big. A whole evening's work would have to be scrapped and much rethinking would be necessary. This happened to me several times.

Another difficulty we met was that of naming things. In our programme the children were asked to choose one of four possible answers. These were lettered A. B. C. and D. The programme was a mathematical one and, conventionally, rectangles and triangles have their corners labelled by letters. Sometimes in the programme we divided a rectangle into two triangles. The temptation to call these triangle A and triangle B was great. Think of the poor children coping with all those letters! No wonder if they became muddled. But what could we call our triangles? Whimsical names somehow did not seem appropriate. Our old friends Alpha and Beta sounded a bit severe, but for want of a better inspiration they had to be used.

Looking back I feel that the most difficult problem is that of making the questions easy enough for the children to get them right and yet difficult enough to require some thought from the child. If the questions are so easy that the child does not have to think enough, then he learns nothing. He makes no contribution to the programme. It almost becomes possible for him to dream through it in the same way that he could dream away any other lesson. But if you demand too much thought the child gets answers wrong and cannot see why. The programme then fails.

After all this it must seem as if writing a programme is just one difficulty after another, but in spite of this I have enjoyed it. It is rather like working out an interesting puzzle or crossword but with far more point to it. It is very satisfying work. Anyway I have not been put off. Besides finishing this one I have agreed to try another, starting from scratch this time.

PROGRAMMED LEARNING AT LAUNDE JUNIOR SCHOOL

R. Botterill

Programmed Learning Booths at
Launde Junior School.

It is some 2½ years since three colleagues joined me in building up what we called 'Reading Boxes'. These were designed to provide a class with another type of activity group. They were aimed at Infant children who had had one or two terms in school. The programme comprised practice in eye line travel, following words and phrases in a well known nursery rhyme, a reading exercise, a story that could be followed fairly easily by identification points and key words, and finally a story for the pleasure of listening. This latter point provided some motivation. The distribution of the instructions for the 'reading boxes' was done by feeding a tape recording to a fourway box equipped to take headphones. We sometimes found it expedient to convert this fourway set up to an eight way point. All the material for each 'reading box' was contained in a storage box and comprised 4 children's work manuals; 4 simple reading texts and one copy of the final story. It was intended that the story would be borrowed by children in the same way that they borrowed from a book corner. I was moderately satisfied with the response it had and I think that with more experience we could have improved on text, organisation and presentation. Events curtailed our activity on this front. We all became busy organising the i.t.a. reading scheme and we left the reading boxes project unfinished. Some feedback from this original idea is beginning again and I assume that this is because of our confidence and familiarity with the i.t.a. I know that work of this nature is being conducted by colleagues and I shall be interested to see their progress. I feel that the basic idea of this type of distribution system is well worth developing with children. I think that the future will demand of my Junior staff that we should help with the transfer back of slow starters in i.t.a. to T.O. This will be one of the techniques that we shall use. The preparation of children's manuals and tapes is tedious, but I feel that they are well worth the time and energy spent on them.

The programmes put on to tape for the reading boxes were directed at our own children and no attempt was made to give them to children outside this school. Throughout this essay I shall only describe work done on behalf of children in this school and sometimes within one class. My interest in this form of programming has stemmed from the simple beginnings of the 'reading boxes' and it was very obvious to my colleagues and myself, without any complicated research work, that when one moves outside ones own environment there are particular and general problems that arise. The obvious one is choice of vocabulary and the second is tone and presentation. We have, therefore, restricted our work and I believe probably saved ourselves much heart searching and soul-destroying re-writing and re-programming. Before anyone enters into making a serious programme of the simplest kind they must be prepared to put much time and effort into it. In our limited field we have found the time factor both in preparation and presentation our biggest problem. Time is an ever precious commodity in school.

Some time after the completion of our 'reading boxes' we were assailed by teaching machines of the linear type and with them some commercial programmes. Now we were faced with the problem of assessing the machines, the programmes and their usefulness to ourselves as teachers. I am pleased to record that though I had a fairly average range of reactions to the 'mechanical teachers' from my staff, I had a very positive action towards the programmes themselves. A number of people set about challenging the commercial writers and here again they proved that with experience, and within the narrow confines of their own children and in the context of their lesson structures, they were able to write successful programmes. This phase did not last long because it was quickly estimated that only certain material is worthy of programming and programmes of the linear type have to be directed at a small range of children and no one had this luxury. I think that the phase of writing programmes, in our case for the Esatutor machines, was an extremely valuable one and I think that when we have to examine commercial programmes in the future this phase more than any other will help us give a fair judgement of what is being presented. I am pleased to say that the joint author of a published programme is presenting a programme of this type in school and no doubt the continued use of this type of presentation will keep alive the discussion of this method.

Most people were agreed that the anti-cheat device of the machines was a very much over-rated safeguard and must have considerably increased production costs. This is borne out by the fact that a simple type of mask can be cut from card and used with effect on the already prepared texts.

Looking back we were rather more prepared for the next stage of our development than appeared at the time. Having sampled a tape recorder system and written programmes we had two mediums with which to experiment. We also had a problem - possibly this problem was of our own making - but never the less it was a challenge. The obstacle was two fold, on one hand we wished to extend the work in language teaching

(French); on the second hand we wished to present bright children with a wider sphere of mathematics without consuming too much more of the teacher's time in the actual teaching. I suppose by now it is very obvious that we turned to our first effort again - the tape recorder. We examined the situation carefully and decided on the course of action. The course in French was solved by the simple expedient of recording good French speaking on to tape and using a helpful response sheet (which is referred to in English) as an aid. Because it is oral in approach this side of the presentation was simple to solve. We decided that we could not afford to have tape reply at the early stages in our growth and thus we rely on the tape to do the initial work and the teacher to examine the response by more traditional approach. There is thus cross reference and a natural reinforcement. I would again point out that within the narrow sphere, some success is bound to be the reward of the programmer if thought and energy have been used in preparation of the programmes.

In dealing with the second problem - mathematics - it was decided that a response sheet to work on during the programme would be a good method of involvement. The response sheet is divided into sections which are referred to by alphabetical identities. Within the section one can find either learning material or space to make a reply in response to tape instructions.

The making of tapes to fit the response sheets has problems of its own. The linkage of response sheet to script has to be carefully worked out before one word is spoken. The actual method of getting over a point is a matter of experience and familiarity with the combined mediums. Much analysis is attributed by programmers to this point. I feel a good teacher has a natural aptitude for it. When one has done a fair practice at this stage the tapes can be prepared. (I shall skip over the recording techniques, which are an essay of their own and are not pertinent to the point). The first tape is a revelation. In spite of a carefully vetted script and every effort, problems of vocabulary, phraseology, leading questions and misreferences will insert themselves and assert themselves. The more time spent on script perfection the better will be the outcome, ad-libbing is definitely not in and anyone who considers that extemporary work on prepared facts and response sheets is a better idea is in for a rude shock. The quality of presentation will suffer and strange as it may seem to the ad-lib supporters the organising of the silent periods is just as important as the verbal periods.

You will note again that I have made no mention of taped replies by the children. This is a luxury for the future if indeed it is needed. The more work I do with this approach to programming the less I am convinced of its necessity and it will come low down on our list of priorities.

Much higher on our list of priorities is the solving of the step size and pace of presentation. The first problem of step size in language may be solved by repetition and the second may also be solved in a similar way with reinforcement side programmes and group instruction from the teacher. In mathematics the problems are not so easily solved. Even though we have directed programmes at high I.Q. children, the variation in their natural response has been quite marked and ranges from thinking ahead of the programme to waiting for the additional prompt. Programme errors have been small but I venture to suggest that this in itself is not a measure of a programme's efficiency. I don't think that narrowing the I.Q. range will solve the problem either. Our present system, which I will give some more details of later, comprises a single track output. Thus a 'one paced' programme is produced to all listeners. Each person has an identical response sheet. When the present programmes have been tried and tested during this year they will need some revision and repacing and this will in some measure meet the situation. It will not be an ideal or good solution, because it is only first aid to a very vital part of programming. Linear programming is bedevilled by this problem. I will be provocative enough to say that with the deterioration of the motivation, that is partly brought about by the system used, be it machine, text, tape or film strip, there will be a loss of interest in linear programmes unless we can successfully find an answer to the pace and step problem.

We are hoping to meet the problem by increasing the number of tracks on the same tape that is fed to the distribution system. On each of the separate tracks will be similar programmes at varying speeds from say a relatively fast one, that is one with short pauses, to a relatively slow one, that is one with longer pauses and possibly additional material. The various paces will be available to the child by switching down the grade of tracks as required by them personally. The technical aspect of this is of no importance, except in so far as we see at the moment that there shall be a device or rule which prevents upgrading. If this is not so then greater problems of tape presentation will arise. It must be remembered that editing a four output tape is a singularly and highly technical operation that will leave many practising teachers bemused in the world of audio science. The question of achieving this multi channel output is very closely tied with finance and will have to be weighed heavily against the reinforcing of programme tapes with pictorial material in the form of automatic slide projection.

One thing that has evolved from our work is that the length of programme with our distribution system must be limited. Sixteen to twenty minutes is the measurable period of the intense concentration. Children subject to longer periods than this have all expressed relief when released from the compelling instructions of the narrator. When ones ears are enclosed in the muffs of the earpieces used one is placed in another lonely world. We have tried to lighten the atmosphere by the introduction of faint music in the background when a 'work pause' is in operation. This happened because of a freak pick up of sound during the recording of a programme and was continued on other programmes deliberately after some children had expressed some pleasure at hearing the music.

Having led you this far I will briefly describe the distribution system, which is of some importance. A small room 18' x 8' has been equipped with a shelf on two sides. The shelves are divided into twelve separate sections called bays. Pairs of bays are equipped with two headsets, two output points and two volume controls so balanced as to prevent complete loss of volume. This latter point is essential in assisting the programmer in fault checking at the start of a programme. All plugs are jack plug type suitable for hard use. The output points are fed by a commercial recorder 4 track/2 speed variety with a 4 track/4 speed variety as a standby. This will meet any tape needs that we foresee in single track distribution. The controls on the tape recorder are easily interpreted and in unsupervised conditions a child could be relied upon to operate the machine. A monitor position is provided for a supervisor. The whole room is well lit to prevent any eye strain or shadows interfering with work. With groups of up to twelve using the bays, rules have been drawn up to facilitate easy common use of the room. One rule is signing ones name in a section diary each time it is used.

I would like to sum up by saying that I feel that there is scope for programming of all types in the primary school, but that we must be quite sure at whom our programmes are directed and that the material being presented is suitable to the child. We must also be certain that the method used will increase the efficiency of the all-important class teacher. There may be some programmes produced that will be suitable for primary children without any influence from the class teacher at all. These I feel will be very limited in number and more strongly I hope they will be limited even further by the more homely efficient programmes of the class teacher who will produce his own particular version and thus preserve that all important personal touch which many of us guard so carefully.

If we are not very careful I feel that this new area of learning will divide itself into three parts - the machine makers, the programmers, the class teachers. My particular fear as far as primary schools are concerned is that these parts will be separate entities who keep to their own narrow paths and argue their own particular reasons for not joining forces. The association of professional programmers and machine makers outside the influence of the school classroom and children is the biggest danger that is to be faced. The best association that is to be had is the teacher/programmer working for the children that will have an influence on the programme content, the attitude and the approach to learning. The teacher who programmes will be increasing his own range of technique and efficiency. The teacher will also be gaining the all important experience of being able to judge and analyse the worth of other programmes through the experience of writing his own. If this is achieved by teachers then I hope to see them as the ally of programming and not as it would appear, as its sceptical enemy. The combination of machine maker (if needed) and the teacher programmer is the ideal combination to be achieved. I can only trust that big business will see it in this light or I fear for the children within the schools who are subjected to programmes prepared in poor and doubtful professional circumstances.

MY EXPERIENCES OF PROGRAMMED INSTRUCTION

J. Clarke

The Clarke Teaching Machine and programme.
Burton-on-the-Wolds.

MY EXPERIENCES OF PROGRAMMED INSTRUCTION

J. Clarke

Burton-on-the-Wolds Primary School is a rural school with just over 90 children on roll. An age group is about 12 - 14 children so our classes average 25. Approximately one quarter of the children come from R.A.F. married quarters in Burton-on-the-Wolds village, the remainder are largely children from the farming community of the surrounding villages. Although classes are relatively small, ability ranges are wide and, I believe, necessitate much individual instruction. Into this background I introduced programmed instruction some three years ago, beginning with the Dienes M.A.B. materials and a card system, devised in the school, for the other mathematical activities. Text books were, largely, discarded, being retained in very limited use for the benefit of the R.A.F. children when we knew they were to leave us. We found that the graded cards, which accompanied M.A.B. material, were satisfactory when used with the more able children but much additional instruction was needed from the teacher to enable the children with lower ability to extract the concepts built in to the materials. The same weakness was found with our own card systems, particularly those dealing with fractions, ratio, spacial concepts and many of the ideas the children experienced when using the concept cards devised by L.G.W. Sealey.

Early in the summer of 1962, I attended a talk given by a representative of T. Nelson & Sons Ltd., on the S.R.A. Reading Laboratory and came away convinced that this was a reading system which would fit into school very well indeed, catering as it did for a wide range of ability and individual progression. I first used the Reading Laboratory in the Autumn term, 1962, and found that its expense was amply justified by the progress, quite striking in some cases, made by the children. I tried to make an objective assessment of its value by giving a reading test, (Schonell's graded word test) and an intelligence test, (Schonell's Essential Intelligence Test of which copies were already in school) both before commencement, and after completion, of the recommended period of 12 weeks use. The gains were remarkable. A few children had gained over 2 years in reading age and there had been gains of more than 10 points in I.Q., which I attributed to increased capacity of comprehension. Throughout the 12 weeks period, the behaviour of the children during the time the Laboratory was in use was worthy of note. From the beginning of the lesson, to the time when they had finally checked their answers, complete silence reigned. There-after, it was almost impossible to stop exchange of experiences which they had enjoyed in their reading. The motivation built into the stories, which formed the basis of the laboratory, was very high indeed and, while the material might have been lacking in high literary merit, it most definitely appealed to the children's tastes and promoted their reading capability. At the same time that I re-tested reading ages and I.Qs, I asked the children to write for me the story which had appealed to them most of all amongst those which they had read. Each one was checked against the original and the similarity of reproduction was quite remarkable. In some cases the original words were quoted and the colour and number of card were known. (The cards are indexed by colour and number). I believe this illustrates the intrinsic interest the material had for the children. That/the Laboratory is written in the American idiom presented little difficulty and the fact that odd words were incorrectly spelt, to us, mattered not one whit. Even my poorest spellers were eager to point out the 'mistakes'.

Experiences with the Reading Laboratory stimulated my interest in programmed instruction and, with great expectancy, Mrs. Clarke and I signed up for a course on the subject, to be held at the School of Education, under the tutelage of Messrs. Leedham, Friis and Bews and Dr. Joselin. In twelve weeks, I believe we were introduced to almost every development there had been in the field at that time and I had been inspired to write my first programme, a simple affair of 120+ frames on area. The subject appeared to fit in very neatly to a regular pattern and also to be very useful in school to follow the commutative law, as dealt with by the Dienes Algebraic equipment. At the same time I spent many hours trying to devise a simple machine which would present the programme in a 'cheat-proof' manner but which was virtually 'snag-proof'. During the course we saw most of the available 'hard-ware' but either it was hopelessly expensive for use in a primary school, or it was inefficient in programme presentation. One such machine fed through a whole programme, exposing only the top sheet as each of the others slipped underneath. Another, whilst being much more satisfactory, 'knitted' (a phrase coined by the children) at least two or three times a week and necessitated 15 minutes attention to dismantle, extricate the shreds of paper (which could not be replaced) and re-assemble. I came to the conclusion that, for all its drawbacks, the only efficient and virtually fool-proof method, for primary use, was the roller feed principle, as in a camera, and the machine I devised embodies this method. Mr. Leedham kindly allocated part of his research grant towards the making of a number of machines and also the production of copies of the Area Programme and this was tried out in a few local schools. The results were illuminating and, to some extent, encouraging. There was obvious motivation in the use of the machine. The knowledge gained at the end of the programme seemed to be at least as good as results I had had by formal teaching methods and the inspiration the children had received prompted some quite outstanding applications of their knowledge with little of my assistance. A number of limitations also became very clear. The choice of vocabulary had to be very carefully controlled. 'Space' does not have the same connotation to the children of to-day that it had to children 30 years ago. The reading ability and intelligence groups had to be carefully considered and fading techniques very closely studied to ensure satisfactory learning. The size of step and amount of material in one frame were also very important points to be considered, as the more intelligent children could soon become bored with material which progressed at too slow a pace and yet this same information could overwhelm those with much less ability, even though they were able to read it.

While this programme was being presented to 10 and 11 year old children, I had the use of the Min Max Mark 11 machine and a number of programmes to fit it. I can report little success with this material which the children found tedious. Some attempt is made to enliven the frames with a few illustrations, but often they were poorly connected with the written explanations and, I believe, the children hardly noted their existence. The motivation of the machine soon disappeared and interest was only maintained through the interest shown by the teacher in the progress the children were making.

During the summer term 5 children took part in Mr. Leedham's experiment, using part of an 'O' level maths programme presented by an Autotutor. Surprisingly, I found that there was almost no motivation from the machine, in fact the children did not like it. However, it was their first experience of a branching type programme and three out of the five children made very good progress through the work. One outstanding example was presented in part of this programme of the care needed in use of vocabulary. One test contained the instruction 'simplify' at the beginning. Three children, not understanding the meaning of the word as it had not been used in the appropriate section of the programme, guessed at its intent and gave incorrect answers throughout. After a short discussion about the word, they repeated the tests, giving almost perfect answers. The machine was in school for only a short period and, to gain maximum use, each child worked with it each day, for one hour. This was too long a period and some children experienced head-aches as a result. During this first period of use of the Autotutor, I gave little personal assistance to the children with the subject matter. However, I have since had further opportunity to use another machine and find that many of the children's objections have disappeared with half-hourly periods of use and assistance given when they are in trouble, usually after two consecutive, incorrect answers.

In July, 1962, I had my first experience of writing a programmed text. This was a programme on Set theory, aimed at a target population with a reading age of 10.5+ and I.Q. of approximately 105+ and intended for use in the top end of the primary and lower classes of the secondary schools. Experience gained in evaluating this programme has been very valuable indeed and has helped to formulate and harden many of the views I now hold. There is no doubt in my mind whatsoever that the effectiveness of programmed instruction depends entirely on the overall motivation to the child and the greatest motivator, in any classroom, is the teacher. If programmed material is presented to most children of primary age and, thereafter, the teacher displays no further interest in either the child's progress or the programme, it is more than likely the results will be unsatisfactory. All my experience, so far, with both elementary and sophisticated methods of presentation, points in the same direction - the teacher cannot be replaced at the primary school level, for any substantial period of time. This does not mean that programmes can only be used for remedial purposes, far from it, but the teacher's role in the classroom where programme instruction is used is just as important as ever - he must be available to act as counsellor and to provide stimulus when difficulties are met. This need is very marked indeed in the use of programmed texts which are so easy to cheat, and which need the exertion of a considerable amount of will-power not to do so. I thought at one time that this did not matter, but experience with the programme on Sets has disproved this. The children so obviously cheated and then arrived at the tests unable to tackle the questions which were almost identical with answers they had been copying.

Much has been written of the social aspects of programmed instruction. If machinery is to replace the teacher, this could become a very serious problem indeed, but I can see little possibility of this, certainly not in the primary school with individual instruction. Group teaching by machine may be a possibility, but surely in this situation the problem will be very different, as the members of the group will be assisting each other to understand the information presented to them. If a comparison be made between a child working on his own, from a text book or programmed material on cards, and a child studying a programmed course presented by a machine, however sophisticated, I can see little difference in the social implications of either situation, assuming that the teacher is on hand to give help when needed. I believe that the real value of programmed instruction in the primary school is that it raises the efficiency of the teacher to a height nothing else can do. I am a very firm believer in individual instruction and in the maxim that every child should progress at his or her own speed in the basic subjects. By widening the use of carefully programmed material, I believe that even with over-sized, unstreamed classes, the day will be very much nearer when this will become possible.

This raises the question of the number and type of programmes which we need for primary children. I believe each programme should be short and have a very definite aim. It is not easy to lay down hard and fast rules about the number of frames but I would suggest 150 - 200 as a very rough guide for the average programme intended for use in the primary school. Much of the difficulty of making a decision about the number of frames arises from the amount of material needed in each frame and the degree of effort required to make an answer. I have seen some American programmes with a page of closely printed material which ended with the instruction 'Copy this word'. On the other hand the question '$2 \in$ (prime numbers). Is this a true or false statement?' requires quite a degree of thought and knowledge. I think we would be on much safer ground if we suggested a time limit as a guide for programme length, remembering of course that children work at different speeds. I have found that in 3 - 5 hours a comprehensive concept can be dealt with and it is then imperative that the concept is applied before continuing with other work. Programme length is also controlled by the amount of knowledge one can assume is held before using the material. As was mentioned earlier, just one word can completely invalidate the testing of the effectiveness of a whole programme. It may be that quite a number of frames must be written in to establish vocabulary before a start can be made on the real meat of the subject. A decision must also be made, before programming can commence, on the amount and type of ancillary equipment needed for the child to use in conjunction with the presented concept. This applies to almost every subject which would be dealt with at primary level, with the possible exception of certain sections of English language. Use of equipment may mean that the number of frames will be increased considerably by the inclusion of many very simple ones, the object being to provide practice in the manipulation of a concept. I have in mind here the demonstration of concepts such as the commutative laws of addition or multiplication, or the various factors of numbers such as 24 or 48.

When all the above decisions have been made, the frame writing can commence and it is at this point, more than any other, that I believe the experience of the practising teacher is needed. From past experience, the teacher knows the difficulties which provide the stumbling blocks to the children. These points must be very carefully programmed, preferably, I believe, from a number of different aspects, so that the final conception can be built up. Ideally, the branching programme is best suited to deal with this type of problem, but my opinion is that, at primary level, little time is wasted by taking children through a variety of steps, assuming that their ability is in the region of that at which the programme is aimed.

The effectiveness of programmed learning is very much in debate, mainly by the theorists, and many opinions appear to be based on very limited experiences. To set up really worthwhile experiments to establish efficiency is extremely difficult as so many variables are involved. So far, I have found that, if a direct comparison is made between time involved and retention, a good programme, in a situation wherethere is teacher-interest and assistance, if needed, is probably very much better for the children than a teacher unassisted by programmed material. I believe this is so because, throughout the learning process, the child is actually involved and does not take up a passive role as happens in many classroom situations.

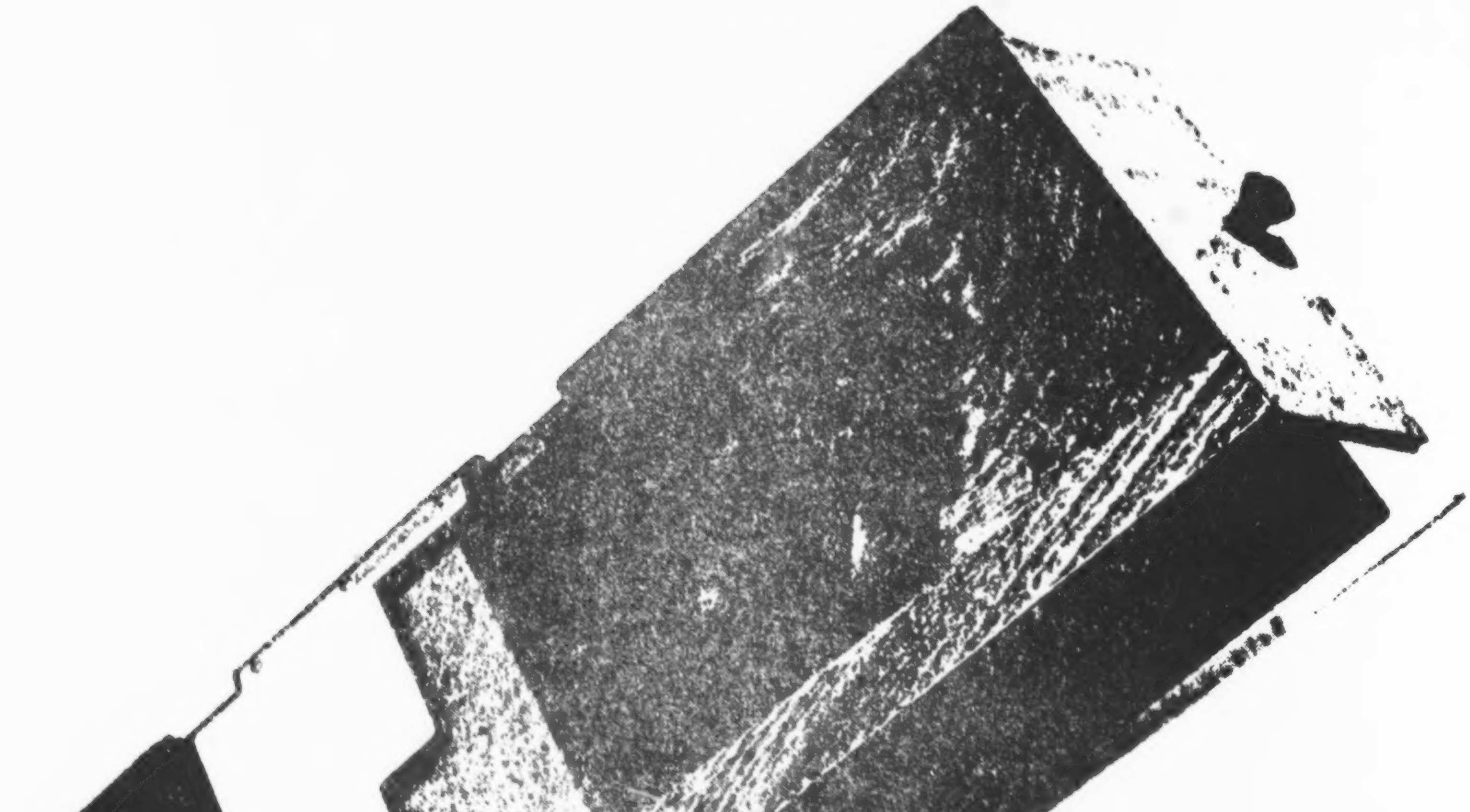
Before summarising my findings, I would like to stress that they have been based on my own limited experiences; first hand use of programmes and machines, both simple and sophisticated, in a rural school already adapted to individual instruction; the writing of linear programmes for a roller-fed machine, developed by myself; the evaluation of a programme text on a subject unheard of by most, if not all, of the children participating in the experiment; information gained from limited reading experience on the subject; and much discussion with many people, much better qualified than I to discuss both psychological and practical aspects. I have, as yet, no experience of group instruction, a limitation which I hope to have opportunity to correct in the not too far distant future.

From present experience, my most definite conclusion is that programmed instruction must be highly motivated to be completely successful and that the teacher is the main source of this motivation. Therefore, it is not a substitute for the teacher, but a means whereby he can work with a much greater degree of efficiency. For the primary school, the programmes must be short, have very definite aims, and be accompanied by uncomplicated ancillary equipment which is cheap or readily available in most schools. The means of presentation should be 'snag-proof' and, preferably, capable of manipulation by the child, including loading and unloading, if a machine. The main need for programmes is to satisfy the requirements of the teacher who has an unstreamed class of from 20 to 50 children; therefore, they must provide mainly for individual instruction so long as we are tied to present buildings and classroom lay-out. The material should be presented so that it is meaningful to the child and is not dealt with as a piece of rote learning. One observation I would like to make concerning target populations (i.e. the group at which a programme is aimed). From my own experience I would suggest that it is almost impossible to define this within very narrow limits. I find that much depends on the child's personal characteristics, possibly even as much as on reading age or intelligence. Children with comparable reading age and I.Qs can differ greatly in the success they achieve in handling a concept presented in a programme. Temperament, perseverance, studiousness and background all have a part to play in the way a child will tackle a problem and it is well nigh impossible to include these characteristics into the data for target population.

In years to come, many of the ideas and opinions now held about programmed learning may have been exploded and proved false. However, I believe it will always be true that this means of communication will be one of the great advances in educational techniques and the teacher who uses good programmed instruction will be very much more efficient than the one who does not.

THE PRODUCTION OF A JUNIOR SCHOOL PROGRAMME IN GEOMETRY

C. Harries



The Probox.
A programme presentation device.
In use at Swannington C. E. School.

THE PRODUCTION OF A JUNIOR SCHOOL PROGRAMME IN GEOMETRY

C. Harries

My interest in programmed learning began almost two years ago when Mr. Leedham and I attended the Annual Conference of the N.U.T. at Scarborough. His English Skills programme was then being developed ready for publication and I was allowed just a glance at the work already done. As might well be the first impression of others, my conclusions were that here was something. It seemed sensible and easy to do once the know-how was achieved. For six months or so I merely played with the idea in my mind - in fact at that time that was all I was capable of doing! During my school work and also my lecturing at the College of Art, I was becoming more convinced that programming lessons was an aid which could prove to be of immense value in the classroom.

By the time, in March 1962, when Mr. Leedham started his course on programmed learning, I had become extremely interested in programming a course on Geometry. I showed my work to other interested colleagues who were prepared to try it out with some of their pupils. It appeared from the results to be quite useful, and my six months of work seemed worthwhile. In fact I thought I had arrived and that after all there wasn't as much in the work as J. Leedham and R. Bews had said. From the course with J. Leedham three of us survived and began our co-operative work with him. It was from here on that I now realised that programming could become a disease which was hard to destroy. The practice of analysis appealed to me and soon I found that my original work was quite weak. Within the many weeks of re-wording and re-framing the programme I had written at least 3 - 400 new frames to supersede the original ones. If from tests the first 20 frames were satisfactory, but the next 5 were unsatisfactory, it meant that however many frames followed, then as far as John Leedham was concerned the 5 needed altering. Eventually I must have written and re-written almost 1,000 frames overa period of 6 months.

The programming group at the University argued the number of frames required to which I should reduce my own programme - it appeared that too small a step could become a bore for many children and also make the programme too long for reasonable consumption. I have a strong tendency to make my approach as intimate and personal as I did in my classroom, but the use of the personal pronoun became too wearing and had to be cancelled.

It was at this stage that I realised that my work would have to be re-done for about the fifth time. I had, however, determined that whatever material I used would be my own and not taken from books.

I had set my target within limits which demanded basic knowledge of Geometry, but after reading modern approaches to Mathematics I realised that something new had to be included and at the end of August my programme had had another facelift which made it suitable and ready for full scale duplicating.

Because I believe Geometry requires a lot of practical work there arose the difficulty of making the programme a reasonable length to include material and practical sections; at this stage I kept them together.

My programme ended at 54 pages and was ready for validation in October, 1963. During our discussions much earlier we had argued the size of frame - format - and type of answer. I had always believed that children need not necessarily answer a frame exactly as the response was given, for it to be marked correct. I felt that children should be allowed sufficient scope to answer in their own language. This I realised would create difficulties with marking at validation stages, but then I believe that a programme is an aid and does not exclude the teacher at any stage of its progress. The frames had, by and large, been developed to make each response easy to arrive at, but at times some responses would require the teacher's opinion.

I did not believe that each frame needed to be answered, consequently many frames were plainly fact-providing. The proof of my technique would only be conclusive when programmes were validated. My sets were sent in groups of 10 to a Primary school in Leicester and Somerset, and to two Secondary Modern schools in Sussex and Derbyshire.

I had hoped to receive the programmes back by Christmas but I had forgotten in my enthusiasm that so much other work had to be done in schools and that one criticism of my work was proved correct. The work was too long and needed pruning. When results did come in, my rather hopeful confident expectations took a blow from one Junior School in particular. The results made me realise that what was suitable locally was not necessarily so away from home. Generally speaking and in a more sensible frame of mind the results were not as frightening as I'd immediately visualised, in fact they were reasonably satisfactory. But the error rate was too high for our satisfaction and it was once more necessary to change my approach to length of frame and presentation. This took three weeks of change and the programme has been shortened in content and all practical work included at the rear as an optional extra to be done in other lessons. I believe that Geometry need not be isolated as part of maths. There is the opportunity to include Arithmetic as Supplementary Angles, Area and Volume and this is now a part of what might be a second programme.

The results of our validation have received critical examination and consequently some criteria for evaluating programmes has been constructed. In fact I think it is safe to write that the original ideas we used to construct our programmes have been well and truly revised. Whereas we looked towards the conclusion we are now more inclined to see the conclusion and work backwards - this is put simply, but of course other factors also arise to flavour our new approach. At times I have found the work tremendously exacting but I hope that the programme as it is now constructed will produce results that may be of some benefit to the children in our schools.

REPORT ON AN EXPERIMENT WITH THE AUTOTUTOR AND AN 'O' LEVEL MATHS PROGRAMME AT KING EDWARD VII GRAMMAR SCHOOL, LEICESTERSHIRE

S. Friis

The Autotutor. South Wigston School.

REPORT ON AN EXPERIMENT WITH THE AUTOTUTOR AND AN 'O' LEVEL MATHS PROGRAMME AT KING EDWARD VII GRAMMAR SCHOOL, LEICESTERSHIRE

S. Friis

Procedure

The Headmaster agreed to take a random sample. It was understood that the machines would be in operation continuously, but because the sample was large and only three machines were available it was possible for each child to have only two 45 minute periods each week.

At first it was anticipated that at least reels 1, 2 and 3 would be available by the end of January, but this was not so. Children who scored highly in the pre-test to reel 1 had no alternative but to work through the reel, although several of them clearly would gain little benefit from the experience.

Children in the sample continued with other mathematics, but the staff agreed not to supplement the machine programme in any way or to deal with the topics covered in their own way.

The machines were set up in a small room leading off from the mathematics classroom. The room was specially prepared by the installation of strip lighting, tables, etc. Thus, conditions were reasonably good, the students having access to the teacher but free of interference.

The Headmaster's co-operation was whole-hearted and sincere. The mathematics staff were open minded, being neither antagonistic nor enthusiastic. Difficulties of administering the work cropped up from time to time. For example, one machine broke down, and it was always necessary to adjust the frame or change the reels for each individual student. As the work proceeded the children assumed responsibility for this without any disadvantages.

Tests.

Dr. Annett of Aberdeen University provided the pre-test to reel 1. Unfortunately the test was not entirely comprehensive, and it was decided that the post-test would have to make good these deficiencies. Thus, the post-test was devised which had the same number of questions (28) of which sixteen were exactly matched and 12 were considerably harder.

General Observations.

Although some 46 children were originally chosen to work on the machines, over half failed to complete reel 1. This was unavoidable being almost entirely due to exam commitments. The children concerned were either Vth or VIth Formers and the staff felt it desirable that they should be allowed to resume normal lessons as soon as possible. In order to keep the machines in full-time use other children took the place of those withdrawn. Because of their late starting, none of these completed reel 1.

I think it is important to realise that although many children did not get as far as the post-test one should not discount the benefits they derived by working through part of the programme. Also a number of children who needed revision in certain topics were allowed to work through the relevant sections of the programme (reels 1, 2 and 3). The staff has stated that using the machine in this remedial capacity proved successful. Apparently, several children, helped in this way have for the first time understood a particular piece of mathematics. Although a small sample only was concerned, this points very strongly to the use of programmed learning to provide remedial or revisionary courses.

Analysis of Results.

	Percentage					
Pre.	Post	Gain	Errors	Time (min)	Form	
56	80	24	26	330	VI	
45	81	36	31	340	IV	Mean
49	68	19	69	250	III	

VI Formers (6)

All of these had covered most of the mathematics involved in Reel 1. In four out of six cases, the gains made were mainly due to the mastery of new material, viz: ordinal and cardinal numbers, conditional and universal equations. Possibly the opportunity to renew acquaintance content of the reel elementary, all said that they had learned something from it. One VIth Former said "I thought I knew it all, but it has helped me to understand more clearly things that I had been using for years".

Despite the lack of difficulty, children were not bored and their interest in the learning process has been maintained at a high level. Indeed several of the children volunteered to work in their lunch-time. It is fair to state that the staff have been surprised by the continued interest.

Although without exception every child had done the work before, gains were made in almost every case. Since reel 1 covers work normally done in the first year and only IInd Formers and above were chosen, it is reasonably certain that none of the mathematical content of the reel was taught simultaneously in the classroom.

We should stress that this experiment seeks not only to validate the programme, but also to find how machine teaching can best be integrated with more conventional approaches.